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Staying Connected – Interactive Student Learning during the COVID Transition to Remote Learning

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ABSTRACT

Background. How can we transition courses in one week, while maintaining a similar experience for students? This was probably the initial response by faculty across universities as they transitioned to remote learning, mid-semester, in response to the SARS-CoV-2 pandemic. Our approach is supported by the ICAP framework which posits that "as activities move from passive to active to constructive to interactive, students undergo different knowledge-change processes and, as a result, learning will increase." (Chi and Wylie, 2014)

Purpose/Hypothesis. How we could foster students' interactions with course material, instructors, and their peers using collaborative technology and course activities? It was hypothesized that a collaborative environment, coupled with appropriately designed activities, would promote the interactive learning described by the ICAP framework.

Design/Method. Faculty members used Microsoft Teams (Teams) and Marquette University's Learning Management System Desire2Learn (D2L) for their courses. Each instructor developed student groups to promote peer and instructor engagement via the Teams channel function.

Results. Initial results from Likert 5-point scale responses support three positive findings to this approach:

- Finding 1 (Instructor Engagement and Student Confidence): Students had a positive reaction to the instructor engagement (4.67 ± 0.6) and student confidence (4.07 ± 1.1).
- Finding 2 (Consistent Coursework): Students reported the amount of work in courses with the interactive tools was consistent (3.90 ± 1.2) with the in-class experience.
- Finding 3 (Collaborative Technology): Using collaborative technology (3.84 ± 1.2) enabled the students to successfully interact with their peers.

The survey also provided data on opportunities for improvement for future on-line courses:

- Opportunity 1 (Communication): Student communication (2.57 ± 1.5) is still a barrier with collaborative technology.
- Opportunity 2 (On-line Format): Students also reported an overall dislike (2.44 ± 1.4) of the on-line learning format.

Conclusions. The use of Teams shows that instructor engagement contributes the most to the positive experiences for confidence, consistency, and use of collaborative technology. We believe there are opportunities to develop more advantages than traditional approaches and will provide students an easier transition to industry, which already use these remote communication tools.

Key Words: virtual teams; mutual learning models; instructional role; interactive learning; collaborative problem-solving; problem-solving studio; ICAP framework; remote learning

BACKGROUND

How can we transition courses in one week? How can we maintain a similar experience for students? This was probably the initial response by the majority of faculty across universities as they transitioned to remote learning, mid-semester, in response to the SARS-CoV-2 pandemic. The challenge with this transition, other than its timing to be in the middle of a term for those on a semester system, is that it brought the convergence of two inexperienced populations into the remote teaching environment.

In our situation, typical of most faculty, none of the authors had taught an online course nor had most of our students completed an online course. To further compound this mid-semester disruption, this occurred in the context of a severely compressed timeline in response to a global pandemic that was underpinned by an unprecedented level of public health uncertainty. Freeman (2015) has concluded that "developing online courses is more time consuming than developing face-to-face courses." In this study, "46% of the respondents complete[d] their online course development in eight weeks or less"; this is in stark contrast to the one-week timeline prompted by Covid responses. The authors all taught problem-based or project-based courses and quickly gravitated towards each other around the strong preference to continue this approach, independent of course delivery mode (i.e., face-to-face or distance). As part of this transition, we focused on how we could continue to foster our students' interactions with course material, instructors, and their peers. We used collaborative technology to facilitate student engagement once we began remote learning.

During this transition, the University and college initiated student and faculty surveys to capture lessons from the student's overall experience. The authors decided to develop a second survey that was administered to their own classes. Several of the authors were already working to integrate Teams into our classrooms and the survey data generated additional feedback to accelerate and improve these courses.

Promoting student interaction and engagement was a cornerstone of the face-to-face version of our courses. Chi and Wylie developed the ICAP framework and show that "as activities move from passive to active to constructive to interactive, students undergo different knowledge-change processes and, as a result, learning will increase." (Chi and Wylie, 2014) In this framework, Chi and Wylie (2014) define "interactive behaviors to dialogues that meet two criteria: (a) both partners' utterances must be primarily *constructive*, and (b) a sufficient degree of turn taking must occur." The behaviors are classified as constructive "as those in which learners generate or produce additional externalized outputs or products." (Chi and Wylie, 2014) Thus, it is the interaction (sufficient degree of turn taking) between learners (dialogue) that generate the new perspectives (constructive) in solving the engineering problem presented to the students that we wanted to foster in our class.

This has been reinforced in pedagogical approaches such as the Problem-Solving Studio (PSS) learning environment by LeDoux and Waller (2016). The PSS "was designed to teach students how to solve difficult analytical engineering problems without resorting to rote memorization of algorithms, while at the same time developing their deep conceptual understanding of the course topics." (LeDoux and Waller, 2016) In this approach, students work in small groups (typically dyads) to analyze problems and develop solutions through interaction with their peers. The interaction with instructors is intended to provide positive reinforcement and "just in time" intervention using the principles of being a reflective teacher outlined by Brookfield (1995). In the PSS, the interactions meet the criteria defined by Chi et al and provide for increased formative assessment opportunities within the learning environment from peers and instructors "in the moment." Furthermore, LeDoux and Waller (2016) measured the impact of this approach on student learning with summative assessments and conclude that "no matter what level of conceptual understanding a student has when they start the course, they can achieve significant gains in conceptual understanding over the semester."

PURPOSE/HYPOTHESIS

As we wrestled with the challenge to develop a "similar experience" to the face-to-face experience to complete the learning outcomes we had embarked to accomplish, we wanted to know if we could we leverage Teams and D2L to promote peer and instructor engagement via the Teams channel function? It was hypothesized that this collaborative environment, coupled with appropriately designed activities, would promote the interactive learning described by the ICAP framework and PSS approach.

DESIGN/METHOD

The authors used Teams and D2L as platforms for their courses. Each faculty member developed student groups to promote peer and instructor engagement during problem-solving activities, topic discussions, or design projects via the Teams channel function. The typical approach was to conduct a synchronous lecture that had imbedded group breakout sections. Several of the authors did augment this approach with asynchronous material (i.e., videos) as either class preparation material or in response to some of the student-led interactions that the instructor felt should be shared with all students in the class. Instead of clustering around a physical table, the groups met in their own Teams channel. The instructor would visit each group's meeting to observe the dialogue and provide real-time feedback. To assess techniques that were working or different approaches that could further augment the student's experience, faculty solicited informal feedback after specific lessons and via office hour engagements. One critical aspect of this approach is that it provided student autonomy to solve the problem via peer interaction in a collaborative manner, as the course had transitioned to a remote learning environment.

The students were provided the opportunity to participate in a voluntary survey designed to understand their perspective and the effectiveness of using Teams / D2L to promote the interactive learning experience that each faculty member valued. Our study was approved by the Marquette University IRB. The survey, administered via Qualtrics, consisted of a combination of Likert scale questions and open responses. The open-ended responses were independently assessed by three authors to classify the main theme(s) conveyed in each response. Any discrepancies in the authors' independent assessments were discussed and updated with a consensus decision. The survey, and this paper, captured the perspectives of students and faculty during a unique transition period experienced in the spring term 2020 and is a valuable part of the future maturation required as higher education responds to future constraints of student-faculty interactions.

RESULTS

The survey received 35 responses, 28% of the total enrollment across the five classes. In summary, 51% of respondents were male and 63% identified as white. All but one respondent were undergraduates, and 51% were juniors. A summary of the use of Teams and courses included in this study is provided in Table 1.

Table 1 – Courses Included in Survey

Dept.	**Course**	**Name**	**#Enrolled**	**Use of Teams**
Computer Engineering	COEN 2610	Software Methodologies	57	Synchronous lectures, group project, breakouts into small groups
Civil Engineering	CEEN 3610	Transportation Engineering	45	Group project, office hours
General Engineering	GEEN 4930	Systems Engineering Principles and Practice	8	Asynchronous lectures, synchronous class activities
Civil Engineering	CEEN 4931	Air Quality Engineering	6	Synchronous lectures, class activities, office hours
Civil Engineering	CEEN 4530/5530	Hazardous and Industrial Waste Management	9	Synchronous lectures, class activities, office hours

The Likert scale and open response results are presented in Figures 1 – 3. The responses provided the following key findings on the student experience with interactive on-line coursework. A distribution analysis (Pareto Analysis), Figure 2, supports the positive experience, defined as more than 75% of the responses scored as a 4 or 5, with instructor engagement, s student confidence, consistent coursework, and collaborative technology. Conversely, communication and on-line were characterized as opportunities as more than 50% of the respondents scored a 1 or 2.

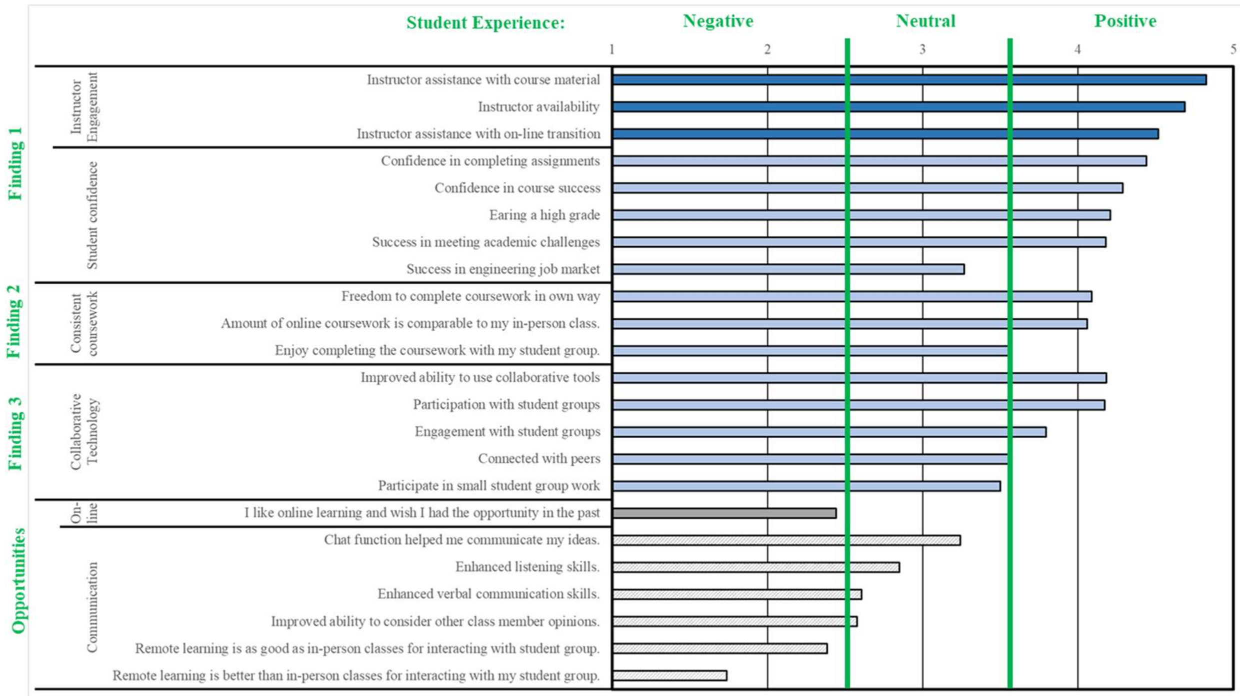


Figure 1: Likert question themes and categories. Likert Question Preface: Please answer the following questions as it relates to remote learning in this engineering course (in comparison to traditional in-person instruction) using the following scale. 1 strongly disagree; 2 disagree; 3 neutral; 4 agree; 5 strongly agree

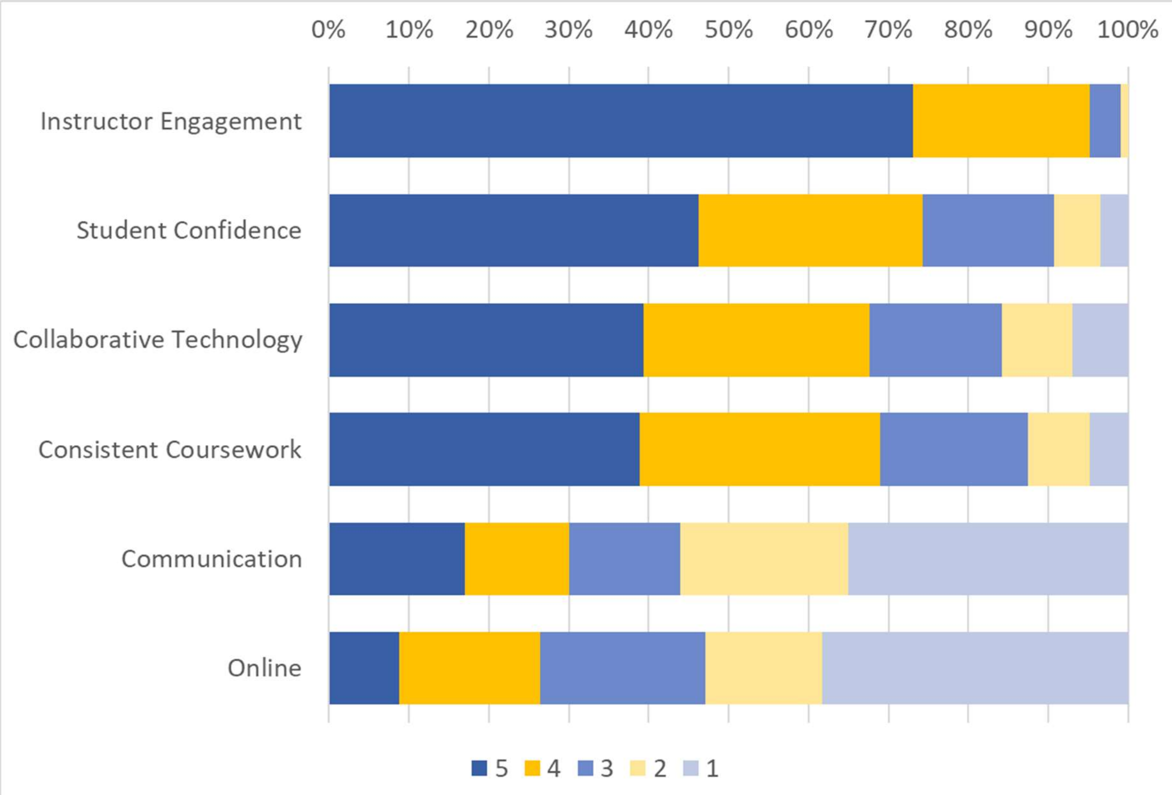


Figure 2: Distribution analysis of the Likert Scale questions reported by thematic category. The number of responses (n) varied based upon the number of questions within each category and not all respondents answered every question. The cumulative percent response is depicted by the line.

Finding 1 (Instructor Engagement and Student Confidence): The students had a positive reaction to the instructor engagement (4.6 ± 0.6) and student confidence (4.1 ± 1.1) in the Likert scale questions (see Figure 1). The frequency distribution shows that there was an overwhelmingly positive response with over 75% of the responses scored as a 4 or 5. The use of interactive tools increased student confidence in their ability to complete assignments, succeed in the course, meet academic challenges, and receive a high grade. The open responses also indicated a high rating for instructor guidance and engagement (see Figure 3a and 3b), which contributed to student's successful transition, confidence, and understanding course expectations.

Finding 2 (Consistent Coursework): The students reported the amount of work in courses with the interactive tools was consistent (3.9 ± 1.2) with the in-class experience. The students reported high scores in overall freedom and ability to complete work as efficiently as the in-class experience. This was a strong, positive response as 70% of the responses were scored as a 4 or 5. This finding highlights the importance of well-designed classroom activities. We did observe that students needed a little more time to complete activities in the on-line environment than traditionally were allotted during the in person setting.

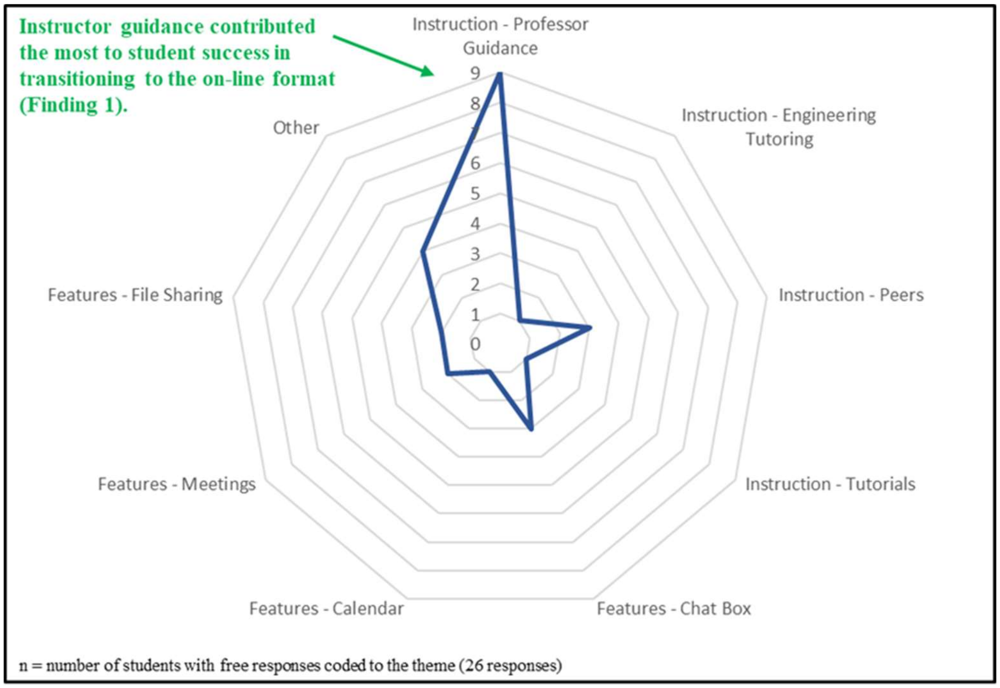
Finding 3 (Collaborative Technology): The use of collaborative technology (3.8 ± 1.2) enabled the students to successfully interact with their peers. The on-line format improved the student's ability to use remote, collaborative tools to complete projects and assignments. This was a strong, positive response as 70% of the responses were scored as a 4 or 5. As Microsoft keeps adding new applications and improving the user experience with Teams, we believe that students will find these useful to their classroom experience and will provide more functionality to complete peer (dyad) or group work.

The survey also provided data on opportunities for improvement for future on-line courses. The opportunities were defined as the themes that had more than 50% of the responses scored as a 1 or 2. It is interesting to note that approximately 25% of the responses were still scored as a 4 or 5. This may be a reflection of the rapid transition (short time to develop activities) and lack of faculty (and possibly student) experience in an on-line environment.

Opportunity 1 (Communication): Students reported the lack of physical presence impairs communication (2.6 ± 1.5) and was still a barrier with collaborative technology. Several factors may contribute to this as some students found themselves in different time zones or had to deal with new environmental factors such as limited bandwidth at home.

Opportunity 2 (On-line Format): The students reported an overall dislike (2.4 ± 1.4) of the on-line learning format. This contrasts with the positive responses found in the findings described above. While not directly measured in our study, the authors hypothesize that this was due to the unexpected transition to distance learning due to COVID-19 and the disruption it posed mid-semester.

3(a): What resources have been the most helpful to you in the transition to Teams?



3(b): Please provide any other comments that you have regarding remote learning in this course this semester.

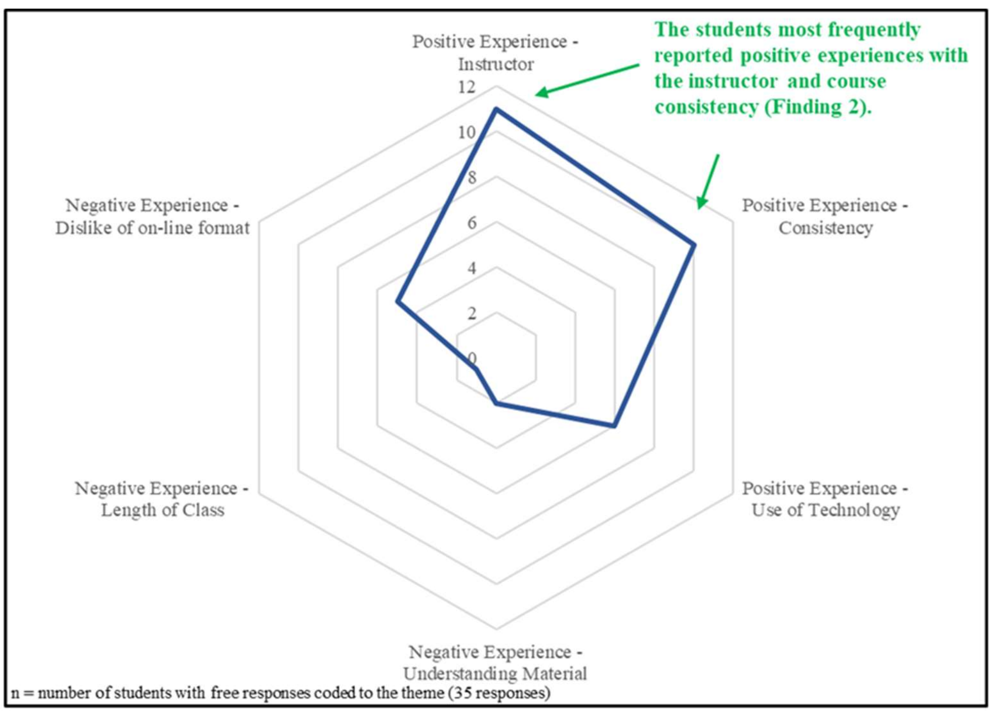


Figure 3: Coded Summary of Free Text Survey Responses.

Instructor Observations: The survey was designed to focus on the student and faculty transition during a unique period. During the reflection of the data, there were several anecdotal themes not directly addressed by our study that further support this approach. The authors observed that students were more likely to use their video and participate in the small group setting than in a larger, course wide setting. One instructor commented that the level of engagement with both the subject matter and their peers increased as this Teams setting provided a more private venue for deeper sharing of ideas that may not have otherwise been shared when the student groups were set within the larger, physical classroom space. While not directly addressed by our study, Povinelli, Brigham, and Cook found that student performance was on par with previous versions of the course as measured by the complexity and completion of the projects and the demonstration of learning outcomes. Starke and McNamara could not make any comparison as they had not previously taught versions of their courses at Marquette but did affirm that the learning outcomes were clearly achieved with excellent student work submitted.

DISCUSSION

The faculty had several observations that, we believe, warrant further consideration as to the advantages of this approach. These might reiterate several observations that other faculty have experienced – so these might be potential "lessons reinforced."

Good teaching practices are still good teaching practices. Although face-to-face instruction is often considered to be interactive by virtue of all attendees in the same physical space, the level of cognitive interaction is not guaranteed. This work demonstrates that if cognitive engagement is achieved, independent of the class setting, student learning is enhanced. Thus, emphasis must be continued to be placed upon the deliberate design of the learning activities in either setting. We would recognize that in the online collaborative environment, more time may be required for dyads to complete tasks.

Collaborative tools may provide distinct advantages over the face-to-face setting. Depending upon the course design and learning activities, we asked if there were any advantages that the Teams approach enabled over traditional (face-to-face) approaches? Again, we believe that the limitation identified in the table below could be integrated into a face-to-face environment as well as the remote environment. Some examples to consider:

Table 2 – Potential opportunities with the Teams Approach

Limitation (Traditional Approach)	Opportunity (Teams Approach)
sketching out concepts on a physical whiteboard and capturing the output with a smartphone camera	sketching out concepts on a digital whiteboard, which you can revisit and revise afterward
emailing documents back and forth and/or the student "divide-and-conquer" approach	real-time sharing of files (multiple authors collaborating at the same time)
groups work independently, then share highlights via report-out	recording group sessions and allowing groups to review each other's sessions
absent student miss activity	absent student reviews recording of activity and potential to have reflective assignment or contribute to the activity file on Teams for the student to still have a cognitive interaction as an assessment opportunity

Preparing students for the engineering profession. As students become accustomed to this work environment, we believe it will result in flexible opportunities for student collaboration (e.g., coordinate students with different schedules) and will provide students an easier transition to industry, which already use these remote communication tools. Several of the authors have decades of experience working on and leading global teams. The immersive experience that the Teams approach provides will help students understand some of their own work preferences as well as identify areas that they can work to improve.

Communication, communication, communication! We see the need to foster effective communication among classmates and student teams. In fairness to all students that were forced to make this transition, faculty should consider what student skills are required to effectively interact in the new environment. Faculty may need to integrate small activities to introduce the functionality of the collaborative tool or promote a new workflow. One author is integrating OneNote to establish course notebooks that can provide a semester long record of the project design. This can be accomplished by introducing a variety of collaborative tools (video, chat, virtual whiteboard) and developing a communication plan with the students based on their preferences early in the semester.

CONCLUSIONS

Our next steps are to continue instructor and peer interaction, which contribute to student confidence in meeting course objectives. The survey shows that instructor engagement contributes the most to the positive experiences for confidence, consistency, and use of collaborative technology. This is a critical consideration as future courses are developed to taken in a remote environment.

There is still no technological substitute for a well-designed learning activity that allows students the ability to explore their curiosity and make connections to discipline knowledge. Without doubt, cognitive interaction results in a deeper, and longer lasting, understanding of the material. The Teams approach described here allowed for that interaction to continue as a rapid transition from one teaching modality (face-to-face) to another (remote learning) occurred. Something that is not able to be explicitly stated from the survey data is the impact of the connection with our students. The authors all had the same personal conclusion that, although we wanted more, the sense of connection via Teams with our students was as vital to our well-being in this uncertain time as we hope it was for our students. This approach provided the opportunity to continue to make "constructive utterances" and ensure we all had "enough turn taking" to have a positive experience.

ACKNOWLEDGEMENTS

The authors want to acknowledge our students! Throughout this unprecedented series of events, we are incredibly proud of their work ethic and perseverance, as well as their steadfast resolve to become the future engineers our society will depend upon. We are humbled, inspired, and grateful to have shared this semester with them. With our sincerest thanks.

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